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Serum and Seminal plasma Metabolized Glutamate levels and BMI in infertile men

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Abstract

Excessive consumption of monosodium glutamate (MSG), a widely used food additive. Increased body mass index (BMI) is associated with metabolic disturbances, hormonal imbalance, and oxidative stress, all of which may adversely affect male reproductive function and increase the risk of infertility.

Aim of study: To investigate the association between Body Mass Index (BMI) and monosodium glutamate (MSG) concentrations in serum and seminal plasma, and to assess their correlations with semen parameters and reproductive hormones in infertile men.

A cross-sectional study was conducted on 75 infertile Iraqi men (mean age 30.4 ± 5.7 years; mean BMI 28.5 ± 5.0 kg/m²). Participants were classified by BMI (normal, overweight, obese). Semen analysis followed WHO guidelines. Serum and seminal MSG were measured, and seminal malondialdehyde MDA as an oxidative stress marker by ELISA, while serum testosterone, FSH, and prolactin were assessed using Mini-VIDAS.

A tendency toward an inverse relationship between Serum glutamate and obese participants was noted, but this did not achieve statistical significance (p=0.056).

A significant negative correlation was found between semen volume and serum glutamate levels ($r = -0.22$, $p < 0.05$), as well as between immotile sperm percentage and seminal MDA levels ($r = -0.32$, $p < 0.05$). Hormonal analysis revealed no statistically significant associations between BMI and testosterone, FSH, or prolactin levels; however, a non-significant increasing trend in FSH levels was observed in obese men.

Oxidative stress was mainly associated with sperm immotility, while serum glutamate showed a weak inverse association with semen volume and tended to be inversely related to obesity.

Keywords: Monosodium Glutamate (MSG); Malondialdehyde (MDA); Oxidative Stress; Male Infertility; Body Mass Index (BMI).

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Introduction

Infertility is defined by the World Health Organization (WHO) as the inability to conceive after one year or more of regular unprotected intercourse. Approximately 17.5% of the adult population, about one in six couples, experiences infertility, with a lifetime prevalence of 17.8% in high-income countries and 16.5% in low- and middle-income countries (1). It is estimated that 20–30% of infertility cases are attributed solely to male factors, and male-related causes contribute to approximately 50% of cases among infertile couples (2).

Male infertility is a complex and multifactorial disorder influenced by genetic, hormonal, metabolic, and environmental factors (3). Recent evidence highlights the role of metabolic and dietary components in male reproductive function, particularly in the context of rising global rates of obesity and associated metabolic dysfunction. Body mass index (BMI) is frequently used as an indicator of adiposity and has been correlated with impaired semen parameters, hormonal imbalance, and systemic oxidative stress, all of which may adversely affect male fertility (4).

Despite advances in reproductive medicine, more than 30% of male infertility cases remain idiopathic, with no clearly identifiable cause (5,6). Studies investigating the relationship between BMI and idiopathic male infertility have yielded inconsistent results. For instance, research conducted among Chinese infertile men found no significant correlation between BMI and sperm concentration, total serum testosterone, or HDL-C levels (7). Similarly, waist circumference (WC) did not show a significant association with semen quality parameters, suggesting that obesity alone may not directly influence idiopathic male infertility (8).

Monosodium L-glutamate (MSG), which is derived from glutamic acid, is widely utilized across the globe as a flavor-enhancing agent and food additive, with its concentrations differing among various food items (9). It is frequently incorporated into numerous processed food products, such as snacks, soups, sauces, and seasoning cubes (10). Evidence from experimental animal models indicates that excessive intake of MSG at elevated doses may negatively impact male reproductive health. These adverse effects include decreased sperm count and motility, disruption of normal testicular function, and inhibition of essential reproductive hormones (11,12). Conversely, glutamate itself is a vital amino acid that participates in multiple critical physiological functions, including neurotransmission, cellular energy production, antioxidant mechanisms, and protein biosynthesis. In the context of the male reproductive system, glutamate contributes positively to sperm physiology by supporting cellular energy balance and maintaining redox homeostasis, thereby promoting optimal sperm function (13,14).

In this context, understanding the impact of external factors such as dietary monosodium glutamate (MSG) on these glutamate-dependent pathways is important, especially considering the rising prevalence of obesity and idiopathic infertility among men, aiming to clarify whether monosodium glutamate could play a contributing role in male infertility.

Materials & Methods

Study Design

The study was conducted as a cross-sectional study in the High Institute for Infertility Diag nosis and Assisted Reproductive Technologies

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/Al-Nahrain University, and Burathaa Lab in Baghdad, Iraq, from September 2024 until June 2025.

Three basic variables were covered: age, body mass index, and dietary patterns. Samples collected from 75 infertile men, with a mean age of 30.757 ±5.28, ranged from 19 to 50 years old. The participants had a mean body mass index (BMI) of 28.5 ± 5.0 kg/m² (15), which indicates that the study population was predominantly overweight. Study participants were categorized based on BMI as normal-weight (BMI <25, n=18), Overweight (BMI 25-30, n=34), and obese (BMI >30, n=22). Furthermore, dietary patterns showed that most participants (61.3%) consumed fast food regularly, whereas only 38.7% followed an organic food diet.

Exclusion criteria were patients with diabetes mellitus, Cancer patients, and those undergoing chemotherapy, Patients with varicocele, genetic mutations, and alcohol consumption.

Seminal fluid analysis

Semen samples were collected after a sexual abstinence period of 2–7 days. Collection was performed in a private room adjacent to the laboratory through masturbation into clean, wide-mouth sterile plastic containers. Samples were allowed to liquefy in an incubator at 37 °C, after which viscosity was assessed by gentle aspiration using a wide-bore plastic pipette. After macroscopic examination according to WHO guidelines, microscopic evaluation was conducted to assess sperm count, concentration, motility, normal morphology, agglutination, and the presence of round cells or other cellular elements. Among the study participants, 13 had normal semen parameters, 40 had oligozoospermia, 45 had teratozoospermia, 17 had asthenozoospermia, and 9 had non-obstructive azoospermia.

Monosodium glutamate and Hormonal analysis in blood serum

Venous blood samples (5 mL) were collected from all study participants and centrifuged, with the separated serum preserved at −20 °C. Serum MSG measure using Eliza (SUNLONG Biotech, China)

Serum levels of follicle-stimulating hormone (FSH), Prolactin, and testosterone were determined using the MiniVidas device (BioMerieux, USA).

Monosodium glutamate analysis and oxidative stress in seminal plasma

For MSG assessment in seminal plasma, the semen samples were centrifuged at 3,000 rpm for 20 min, and the supernatant was carefully separated from the pellets and well-kept at −20°C. Glutamate levels were measured using an enzyme-linked immunosorbent assay (ELISA) kit (SUNLONG Biotech, China) with a sensitivity concentration of 0.5µmol/L Using the double-sandwich ELISA technique, the micro-ELISA plates were pre-coated with human glutamate-specific antibody for accurate quantitative detection. The study was approved by the Department of Applied Embryology, High Institute for Infertility Diagnosis and Assisted Reproduction.

Results:

This study included 75 infertile Iraqi men with a mean age of 30.4 ± 5.7 years (Table 1). The participants had a mean body mass index (BMI) of 28.5 ± 5.0 kg/m², which indicates that the population was predominantly overweight. The dietary patterns shown in Table 2 indicated that most participants (61.3%) consumed fast food regularly, whereas only 38.7% followed an organic food diet.

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Seminal fluid analysis

Moving to the primary fertility indicators, semen analysis revealed widespread abnormalities across multiple parameters (Table 3). The median sperm concentration was 8.0 [1.7-21.5] million/ml, which falls below the WHO reference value of 15 million/ml. Consequently, 62.7% of participants showed abnormal sperm concentration. Similarly, the total sperm count was abnormal in 64.0% of cases, with a median of 23.0 [4.5-63.0] million. Moreover, sperm motility parameters were also compromised.

Progressive motility averaged 29.4 ± 19.2%, with 46.7% of participants falling below the normal threshold of 32%. Total motility showed similar patterns, with 42.7% of participants presenting abnormal values. Most notably, sperm morphology was severely affected: 73.3% of participants had abnormal morphology, with a median of only 1.0% [1.0-4.0] normal forms, compared with the reference value of >4%.

Serum levels of sex hormones and prolactin

Hormonal assessment showed varying patterns of dysfunction (Table 4). While most participants (72.7%) maintained normal FSH levels, 21.8% showed elevated values and 5.5% had low levels. Prolactin levels were elevated in 36.7% of participants, with none showing low values. Regarding testosterone, approximately one-quarter of participants (24.3%) had low levels, while the majority (72.9%) remained within the normal range.

Table 1: Clinical outcomes of embryo assessment technologies in assisted reproductive technology

Continuous variables			
Variable	**Mean ± SD**	**Median [IQR]**	**Range**
Age, years	30.4 ± 5.7	29.0 [26.5-34.0]	19.0-46.0
BMI, kg/m²	28.5 ± 5.0	28.2 [25.3-30.9]	17.9-41.1
Weight, kg	86.4 ± 16.8	85.0 [74.2-95.0]	58.0-150.0
Height, cm	174.1 ± 8.2	173.0 [169.0-180.0]	158.0-198.0

Table 2. Lifestyle factors distribution (N= 75).

Factor	**n (%)**
Dietary pattern	
Fast food	46 (61.3%)
Organic food	29 (38.7%)

Table 3: Semen Analysis Parameters According to WHO 2021 Reference Values.

Parameter	**Mean ± SD**	**Median [IQR]**	**Reference range**	**% Abnormal**
Volume (ml)	3.2 ± 1.6	3.0 [2.0-4.0]	1.5-5.0	14.7%
pH	7.5 ± 0.1	7.5 [7.5-7.5]	7.2-8.0	0.0%
Concentration (10^6/ml)	13.9 ± 15.8	8.0 [1.7-21.5]	>15	**62.7%**
Total Count (10^6)	42.0 ± 54.2	23.0 [4.5-63.0]	>39	**64.0%**
Progressive motility (%)	29.4 ± 19.2	32.0 [12.0-46.0]	>32	46.7%
Total motility (%)	39.1 ± 23.3	43.0 [23.0-56.0]	>40	42.7%
Normal morphology (%)	2.6 ± 3.5	1.0 [1.0-4.0]	>4	**73.3%**

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Table 4. Distribution of Hormone Levels.

Hormone	Mean ± SD	Reference range	Low	Normal	High
FSH (mIU/ml)	9.46 ± 11.23	1.5-12.4	3 (5.5%)	40 (72.7%)	12 (21.8%)
Prolactin (ng/ml)	14.50 ± 6.47	4.0-15.2	0 (0.0%)	31 (63.3%)	18 (36.7%)
Testosterone (ng/ml)	4.06 ± 1.73	2.8-8.0	17 (24.3%)	51 (72.9%)	2 (2.9%)

Progressive motility averaged 29.4 ± 19.2%, with 46.7% of participants falling below the normal threshold of 32%. Total motility showed similar patterns, with 42.7% of participants presenting abnormal values. Most notably, sperm morphology was severely affected: 73.3% of participants had abnormal morphology, with a median of only 1.0% [1.0-4.0] normal forms, compared with the reference value of >4%.

Serum levels of sex hormones and prolactin

Hormonal assessment showed varying patterns of dysfunction (Table 4). While most participants (72.7%) maintained normal FSH levels, 21.8% showed elevated values and 5.5% had low levels. Prolactin levels were elevated in 36.7% of participants, with none showing low values. Regarding testosterone, approximately one-quarter of participants (24.3%) had low levels, while the majority (72.9%) remained within the normal range.

Glutamate and MDA levels

The study showed different patterns between blood and seminal plasma (Table 5). Blood glutamate levels averaged 3.61 ± 2.14, while seminal plasma glutamate was slightly lower at 3.01 ± 1.09. Additionally, the oxidative stress marker MDA in seminal plasma averaged 38.65 ± 11.90, which indicates considerable oxidative stress in the reproductive system.

Table 6, showed a significant negative correlation with the percentage of immotile spermatozoa ($r = -0.32$, $P \leq 0.05$), while no significant correlations were observed with other semen parameters ($P > 0.05$). A significant negative correlation was detected between blood glutamate levels and semen volume ($r = -0.22$, $P \leq 0.05$). No significant associations were found between glutamate levels in either blood or seminal plasma and the remaining semen parameters ($P > 0.05$).

Table 5. Glutamate and MDA Levels.

Marker	Sample	Mean ± SD	Median [IQR]	Range
Study biomarkers				
Glutamate	Blood serum	3.61 ± 2.14	2.97 [2.46-3.84]	1.63-13.17
	Seminal plasma	3.01 ± 1.09	2.76 [2.17-3.73]	1.25-6.44
Oxidative stress marker				
MDA	Seminal plasma	38.65 ± 11.90	31.90 [30.30-51.85]	24.70-63.13

MDA, malondialdehyde.

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Table 6: Estimate of the Correlation Coefficient Between Semen Parameters with MDA and Glutathione in the Study Samples

Semen parameters	Correlation coefficient-r		
	P - MDA	P - Glutamate Blood	P - Glutamate Seminal
Volume	-0.13	-0.22 *	-0.02
Concentration	0.12	-0.03	-0.09
Count	0.07	-0.10	0.02
Progressive Motile Sperms %	0.12	-0.02	-0.06
Non-progressive Motile Sperms %	0.08	-0.06	-0.10
Immotile Sperm %	-0.32 *	0.16	-0.06
PH	-0.09	0.02	0.07

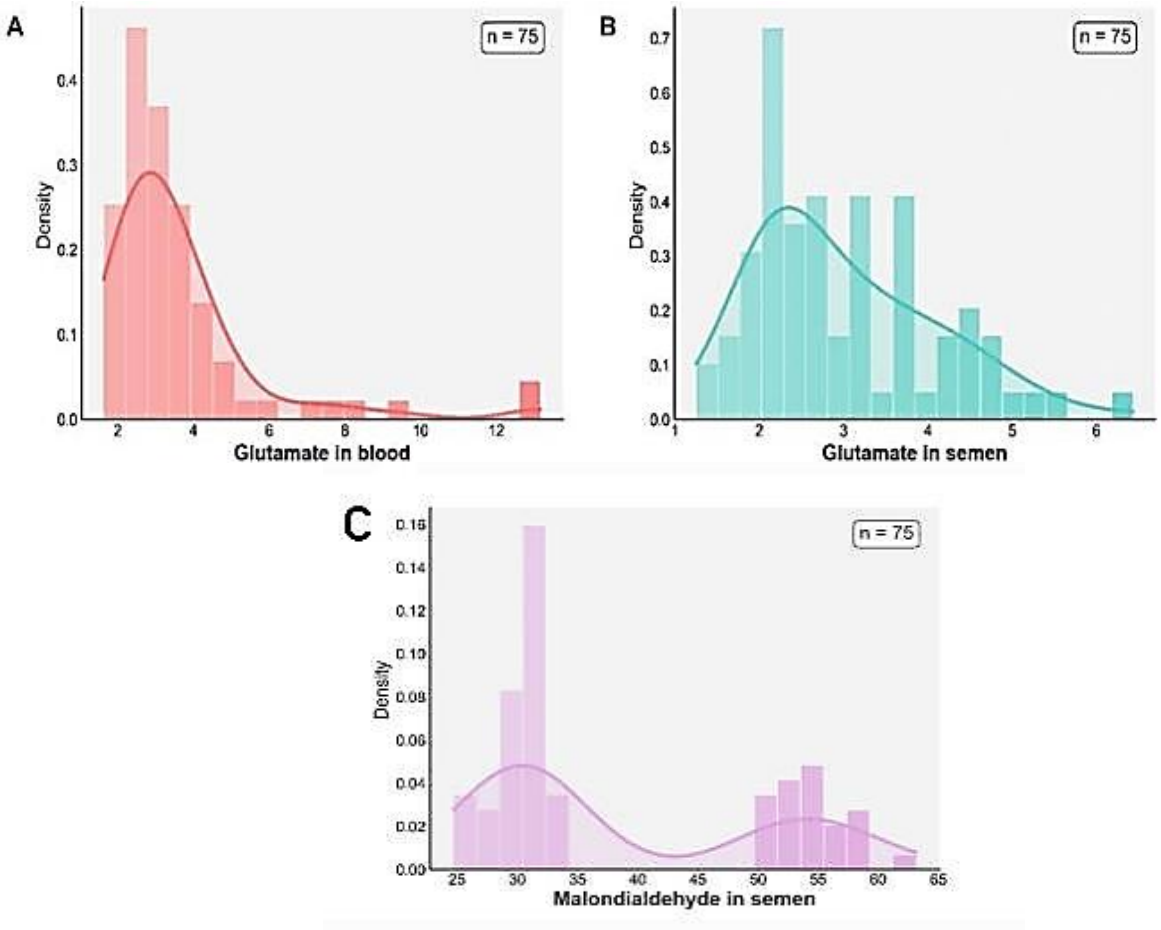

Figure 1: Distribution of biochemical markers in blood and seminal plasma samples from infertile Iraqi men. Histograms with overlaid kernel density estimation curves showing the distribution of: A) glutamate concentration in blood, B) glutamate concentration in seminal plasma, C) malondialdehyde (MDA) concentration in seminal plasma. Sample sizes (n) are indicated for each measurement. The density curves illustrate the probability distribution of each biomarker, with shaded areas representing the data spread.

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Semen parameters across BMI

The analysis of semen parameters across BMI categories revealed no significant associations (Figure 2). Normal weight participants (BMI <25, n=18) had slightly lower semen volumes (median 2.60 ml) compared to overweight (BMI 25-30, n=34, median 3.00 ml) and obese participants (BMI >30, n=22, median 3.00 ml), though these differences were not statistically significant ($p>0.05$). Moreover, sperm concentration showed a non-significant trend toward lower values in obese men (median 3.85 × 10^6/ml) compared with normal-weight (median 9.00 × 10^6/ml) and overweight participants (median 8.50 × 10^6/ml; $p>0.05$). Progressive motility followed a similar pattern, with obese men showing the lowest values (median 23.00%) compared to overweight (median 40.00%) and normal weight participants (median 32.00%, $p>0.05$). Normal morphology percentages were comparable across all BMI categories ($p>0.05$).

Glutamate and MDA biomarkers across BMI categories

Analysis of biomarkers across BMI categories revealed a tendency toward an inverse relationship between Serum glutamate and obese participants, but this did not achieve statistical significance ($p=0.056$) (Figure 4). Obese participants showed lower blood glutamate concentrations (median 2.62) compared to normal weight (median 3.15) and overweight individuals (median 3.22, $p<0.056$). This finding suggests a probable relationship between body weight and glutamate metabolism. Nevertheless, seminal glutamate levels did not follow this pattern, showing similar concentrations across all BMI categories ($p>0.05$). Seminal MDA levels showed no significant associations with BMI categories ($p>0.05$ for both).

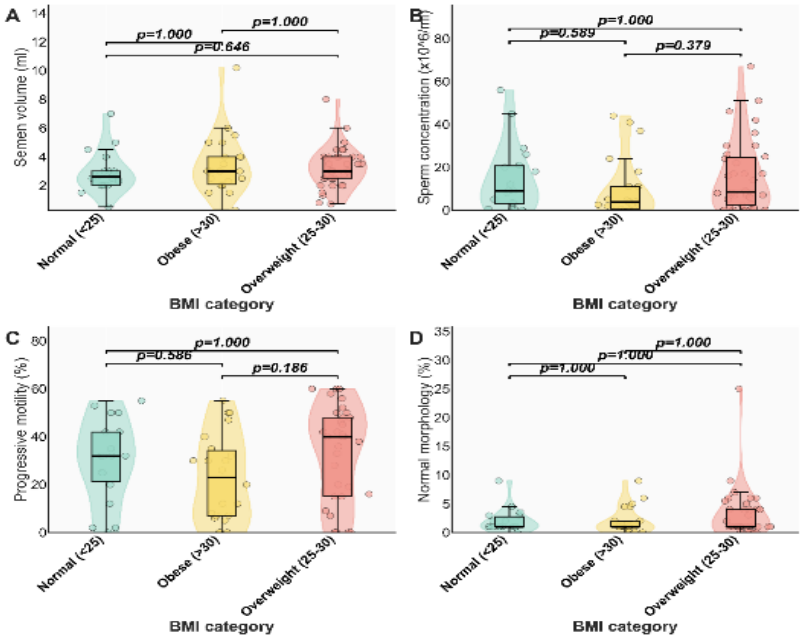

Figure 2. Box-violin plots showing semen parameters by BMI category: A) semen volume by BMI category, B) sperm concentration by BMI category, C) progressive motility percentage by BMI category, D) normal sperm morphology percentage by BMI category. Each panel shows the distribution using violin plots, box plots (median and IQR), and individual data points. Significant values ($p\leq0.05$) are displayed in red.

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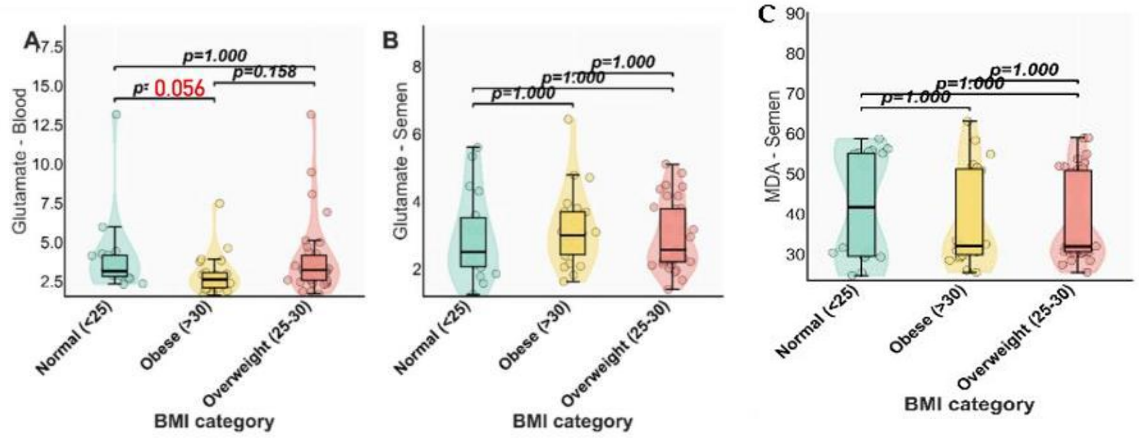

Figure 3. Box-violin plots showing biomarker levels by BMI category: A) glutamate (blood) by BMI category, B) glutamate (semen) by BMI category, C) MDA (semen) by BMI category. Each panel shows the distribution using violin plots, box plots (median and IQR), and individual data points. Significant values ($p \leq 0.05$) are displayed in red.

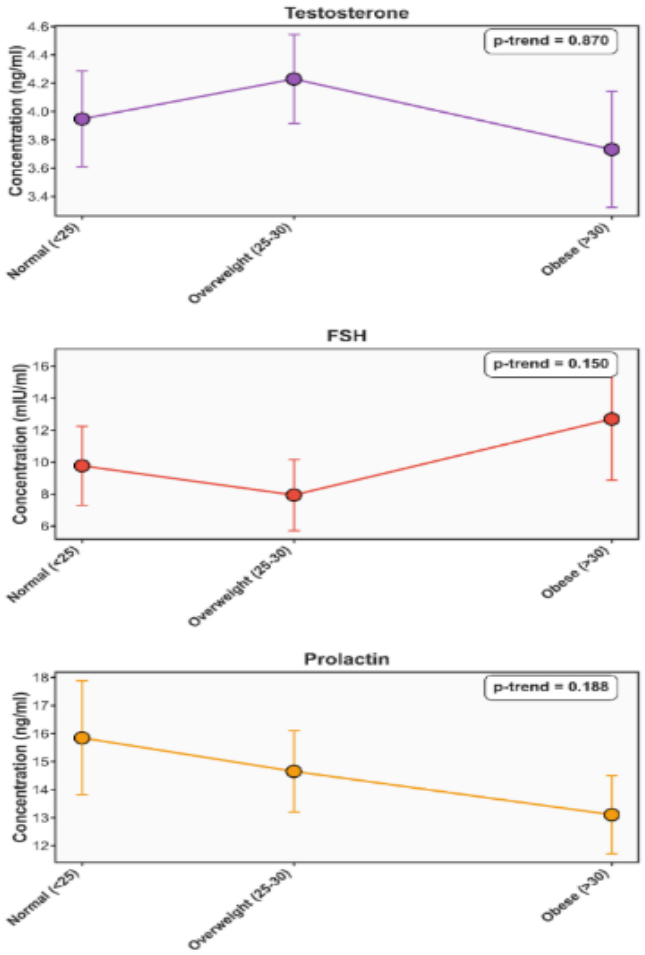

Figure 4. Subgroup analysis by BMI categories shows hormones (testosterone, FSH, and prolactin) among three BMI groups (Normal <25, Overweight 25-30, Obese >30). P-trend values from Pearson correlation analysis with BMI as continuous variable.

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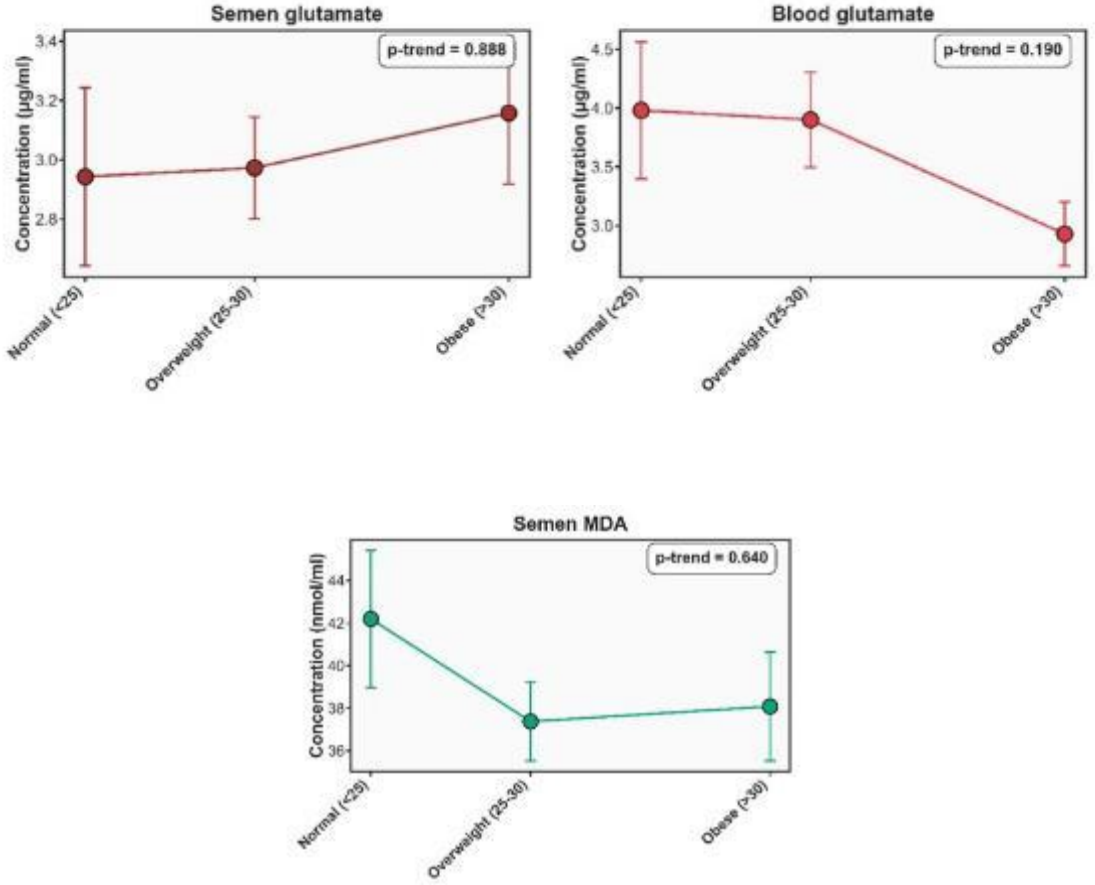

Figure 5. Subgroup analysis by age categories shows semen parameters (volume, pH, concentration, progressive motility, total count, and normal morphology) among four age groups (<25, 25-30, 31-35, >35 years). P-trend values from Pearson correlation analysis with age as continuous variable.

Discussion:

As shown in Table 1, the demographic characteristics of the 75 infertile Iraqi men included in the current study, the mean age of 30.4 ± 5.7 years (range 19-46 years) is the typical reproductive age when couples actively follow fertility evaluation, aligning with regional studies (16). examined similar age populations of Iraqi infertile men. Also, the notably elevated mean of 28.5 ± 5.0 kg/m2 is particularly noticeable, as it places the majority of the population in the overweight category according to WHO classifications, a finding that mirrors the broader obesity epidemic in Iraqi society and is consistent with multiple Iraqi fertility studies that have reported similar BMI elevations in infertile males (16,17).

Semen parameters across BMI

As shown Figure 2, demonstrate lack of statistically significant BMI associations with semen parameters, despite trends toward worse outcomes in obese men (concentration 3.85 vs 9.00 × 10^6/ml in normal weight), contrasts sharply with the strong literature demonstrating BMI is impact on fertility (18). In their large cohort study found significant decreases in volume, concentration, and motility with increasing BMI, while other study reported

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oligozoospermia rates rising from 5.32% in normal weight to 15.62% in obese men (19).

Blood glutamate, MDA and SFA

The correlation analysis revealed a statistically significant negative association between blood glutamate levels and semen volume, suggesting that elevated systemic glutamate may adversely affect seminal fluid production. This finding may indicate a potential systemic influence of glutamate on accessory sex gland function. These results are consistent with previous findings in bucks, where MSG exposure led to dose-dependent reductions in semen volume (20).

The glutamate and BMI categories

According to Figure 4 show tendency toward an inverse relationship between Serum glutamate and obese participants was noted, but this did not achieve statistical significance (p=0.056). Reveals complex metabolic alterations in obesity beyond simple oxidative stress. In contrast to (21). who observed an association between reduced glutamate levels and abnormal sperm morphology, the present finding implies that BMI-related variations in glutamate might act through pathways different from those directly impacting sperm characteristics. The progressive decline in blood glutamate (3.98 to 2.93) with increasing BMI reveals metabolic alterations potentially impacting spermatogenesis at the cellular level. These biomarker changes suggest that obesity induces metabolic dysregulation affecting amino acid metabolism which could compromise sperm production through mechanisms not immediately apparent in conventional semen analysis. The consistent directional trends across multiple domains, motility decline, FSH elevation, and metabolic biomarker alterations, support the biological plausibility of obesity's detrimental impact on male fertility, emphasizing the need for weight management as part of comprehensive infertility treatment even when initial semen parameters appear unaffected.

MDA and Hormonal profile with BMI categories

According to Figure 5 illustrated increasing FSH trend with obesity (9.78 to 12.70 mIU/ml, p=0.150) suggests compensatory pituitary stimulation responding to impaired testicular function, consistent with (22). who found mild but significant BMI-hormone relationships in sub fertile men. The biomarker analysis of significant oxidative stress burden and metabolic alterations in our infertile patients, with the elevated seminal MDA levels (38.65 ± 11.90) providing direct evidence of lipid peroxidation within the reproductive tract. This finding aligns strongly with multiple studies demonstrating increased oxidative stress markers in infertile men (23) reported significant MDA accumulation negatively correlated with sperm motility and morphology, while the meta-analysis (24) across 65 studies confirmed consistently elevated MDA and decreased antioxidant capacity in infertile populations.

Conclusion

The results indicate a potential role of oxidative stress in male infertility, particularly reflected by the significant association between seminal MDA levels and sperm immotility. Serum glutamate showed a weak but significant inverse correlation with semen volume, while no significant associations were observed with other semen parameters. Additionally, an inverse trend between serum glutamate levels and obesity was noted without reaching statistical significance. Further studies with larger sample sizes are required to better elucidate the role of glutamate

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metabolism and oxidative stress in male reproductive function.

Ethical Approval: The study was approved by the Department of Applied Embryology, High Institute for Infertility Diagnosis and Assisted Reproductive Technologies (code: 0702-MF-2025M70-C1)

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Conflicts of interest: The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

Author contributions

All authors contributed to the collection of data, the preparation of the draft, and the review and approval of the final version of the manuscript.

REFERENCES

1. World Health Organization. Infertility prevalence estimates, 1990–2021. *World Health Organization*; 2023 Apr 4.
2. Agarwal A, Baskaran S, Parekh N, Cho CL, Henkel R, Vij S, Arafa M, Selvam MK, Shah R. Male infertility. *The Lancet*. 2021 Jan 23;397(10271):319-33. https://doi.org/10.1063/1.5138577
3. Hanon MS, Mazhir SN, Hussein EA. Effect of dielectric barrier discharge on sperm motility and influence on oxidative stress in patient with asthenospermia. *InAIP Conference Proceedings* 2019 Dec 11 (Vol. 2190, No. 1, p. 020091). AIP Publishing LLC.
4. Service CA, Puri D, Al Azzawi S, Hsieh TC, Patel DP. The impact of obesity and metabolic health on male fertility: a systematic review. *Fertility and sterility*. 2023 Dec 1;120(6):1098-111. https://doi.org/10.1016/j.fertnstert.2023.10.017
5. Minhas S, Bettocchi C, Boeri L, Capogrosso P, Carvalho J, Cilesiz NC, Cocci A, Corona G, Dimitropoulos K, Gül M, Hatzichristodoulou G. European association of urology guidelines on male sexual and reproductive health: 2021 update on male infertility. *European urology*. 2021 Nov 1;80(5):603-20. https://doi.org/10.1016/j.eururo.2021.08.014
6. Agarwal A, Parekh N, Selvam MK, Henkel R, Shah R, Homa ST, Ramasamy R, Ko E, Tremellen K, Esteves S, Majzoub A. Male oxidative stress infertility (MOSI): proposed terminology and clinical practice guidelines for management of idiopathic male infertility. *The world journal of men's health*. 2019 Sep 1;37(3):296-312. https://doi.org/10.5534/wjmh.190055
7. Ma JX, Wang B, Li HS, Jiang XJ, Yu J, Ding CF, Chen WQ. Association between obesity-associated markers and semen quality parameters and serum reproductive hormones in Chinese infertile men. *Reproductive Biology and Endocrinology*. 2020 Sep 29;18(1):95. https://doi.org/10.1186/s12958-020-00652-6
8. Rajamanickam S, Nichanahalli KS, Chaturvedula L. Impact of obesity on semen quality in men of infertile couples: a cross-sectional study in a tertiary care centre. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*.;11(5):1502. https://dx.doi.org/10.18203/23201770.ijrcog20221284
9. Walker R, Lupien JR. The safety evaluation of monosodium glutamate. *The Journal of nutrition.* 2000 Apr 1;130(4):1049S-52S. https://doi.org/10.1093/jn/130.4.1049S
10. Cebi N, Dogan CE, Olgun EO, Sagdic O. A survey of free glutamic acid in foods using a robust LC–MS/MS method. *Food chemistry*. 2018 May 15;248:8-13. https://doi.org/10.1016/j.foodchem.2017.12.033
11. Oluwole DT, Ebiwonjumi OS, Ajayi LO, Alabi OD, Amos V, Akanbi G, Adeyemi WJ, Ajayi AF. Disruptive consequences of monosodium glutamate on male reproductive function: A review. *Curr. Res. Toxicol*, 6, 100148 [Internet]. 2024. https://doi.org/10.1016/j.crtox.2024.100148
12. Kayode OT, Rotimi DE, Kayode AA, Olaolu TD, Adeyemi OS. Monosodium glutamate (MSG)-induced male reproductive dysfunction: a mini review. *Toxics*. 2020 Jan 22;8(1):7. https://doi.org/10.3390/toxics8010007

AIMCJ. (2026),3; (2):1-12
https://doi.org/10.58564/AIMCJ3.2.20226.243

13. Ortiz-Rodríguez JM, Martín-Cano FE, Gaitskell-Phillips G, Silva A, Tapia JA, Gil MC, Redondo E, Masot J, Ortega-Ferrusola C, Peña FJ. The SLC7A11: sperm mitochondrial function and non-canonical glutamate metabolism. *Reproduction*. 2020 Dec 1;160(6):803-18. https://doi.org/10.1530/REP-20-0181
14. Mutluay SU, Karataş H. A review of glutamate and its receptors: their roles in brain physiology and pathology. *Acta Medica*. 2022 Jun 13;53(2):99-109. https://doi.org/10.32552/2022.ActaMedica.650
15. Shaker AM, Nuaman BN. The Metabolic and Hepatic Impact of Central Obesity in MASLD Patients: Evidence from an Iraqi Cross-sectional Cohort. *Al-Iraqia Medical College Journal*. 2025 Dec 15;2(3):54-64. https://doi.org/10.58564/AIMCJ2.3.2025.234
16. Yenzeel JH. Effect of body mass index on sperm parameters and sex hormone level in sample of infertile Iraqi men. *Iraqi Journal of Science*. 2017:1428-36. https://doi.org/10.24996/ijs.2017.58.3B.7
17. Alsaid S, Khalafalla K, Majzoub A, Arafa M, Elbardisi H. Impact of body weight on semen parameters and reproductive hormones of men with idiopathic infertility. *Fertility and Sterility*. 2019 Sep 1;112(3):e369.
18. Belloc S, Cohen-Bacrie M, Amar E, Izard V, Benkhalifa M, Dalléac A, de Mouzon J. High body mass index has a deleterious effect on semen parameters except morphology: results from a large cohort study. *Fertility and sterility*. 2014 Nov 1;102(5):1268-73. https://doi.org/10.1016/j.fertnstert.2014.07.1212
19. Hammoud AO, Wilde N, Gibson M, Parks A, Carrell DT, Meikle AW. Male obesity and alteration in sperm parameters. *Fertility and sterility*. 2008 Dec 1;90(6):2222-5. https://doi.org/10.1016/j.fertnstert.2007.10.011
20. Boyi A, Oyeyemi MO, Wahab AT. Effects of oral administration of Monosodium glutamate (msg) on semen characteristics and sperm morphology of the West African Dwarf bucks (Capra hircus). *Journal of Animal Science and Veterinary Medicine*. 2022 Dec;7(6):176-84.
21. Sugiyama T, Terada H, Miyake H. Assessment of blood plasma free-amino acid levels in infertile men. *in vivo*. 2021 May 1;35(3):1843-7. DOI: https://doi.org/10.21873/invivo.12446
22. Bieniek JM, Kashanian JA, Deibert CM, Grober ED, Lo KC, Brannigan RE, Sandlow JI, Jarvi KA. Influence of increasing body mass index on semen and reproductive hormonal parameters in a multi-institutional cohort of subfertile men. *Fertility and sterility*. 2016 Oct 1;106(5):1070-5. https://doi.org/10.1016/j.fertnstert.2016.06.041
23. Benedetti S, Tagliamonte MC, Catalani S, Primiterra M, Canestrari F, De Stefani S, Palini S, Bulletti C. Differences in blood and semen oxidative status in fertile and infertile men, and their relationship with sperm quality. *Reproductive biomedicine online*. 2012 Sep 1;25(3):300-6. https://doi.org/10.1016/j.rbmo.2012.05.011
24. Huang C, Cao X, Pang D, Li C, Luo Q, Zou Y, Feng B, Li L, Cheng A, Chen Z. Is male infertility associated with increased oxidative stress in seminal plasma? *A-meta analysis. Oncotarget.* 2018 May 11;9(36):24494. https://doi.org/10.18632/oncotarget.25075